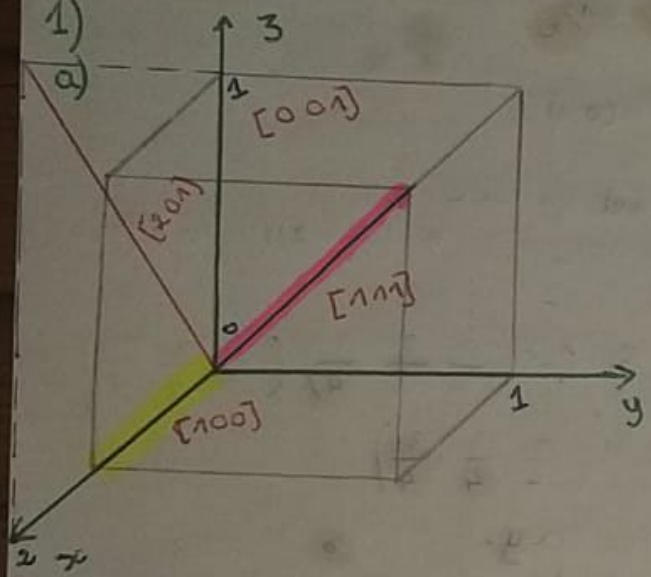
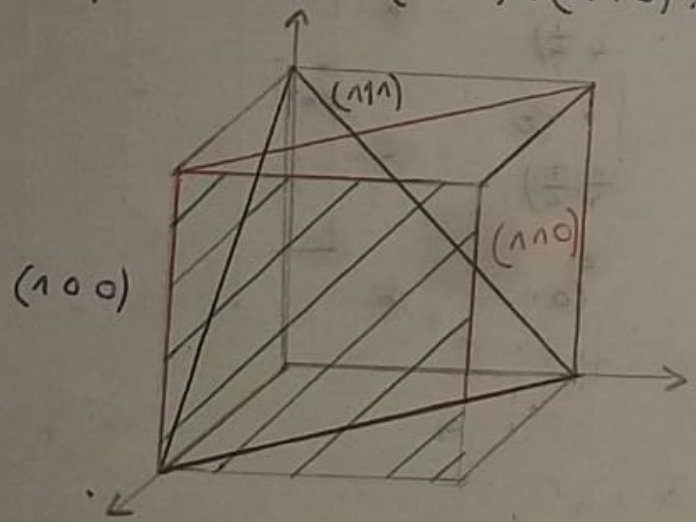
Chimie minérale

Exercice 1

1) a)

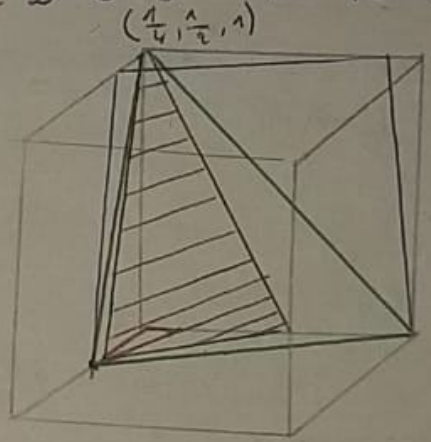


b) Le plan d'indice : (100) , (110) , (111)



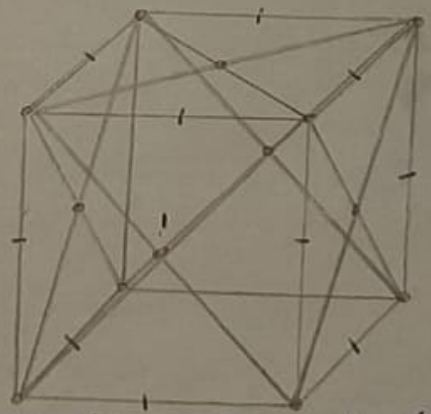
2)

	x	y	3	Inverse			R	R P	PR
$\frac{a}{2}, b, 2c$	1/2	1	2	2	1	1/2	4	2 1	$\begin{cases} ox = \frac{1}{4} \\ oy = \frac{1}{2} \\ oz = 1 \end{cases}$
$3a, b, \infty c$	3	1	∞	1/3	1	0	3	3 0	$\begin{cases} ox = \frac{1}{3} \\ oy = \frac{1}{3} \\ o3 = 0 \end{cases}$
$\frac{a}{3}, b, c$	$\frac{1}{3}$	1	1	3	1	1	3	1 1	$\begin{cases} ox = \frac{1}{3} \\ oy = \frac{1}{3} \\ o3 = 1 \end{cases}$
$2a, 6b, 3c$	2	6	3	1/2	1/6	1/3	3	1 2	$\begin{cases} ox = 1/3 \\ oy = 1 \\ o3 = 1/2 \end{cases}$



Exercice 2

1)



2) nbr de O^{2-} $\quad 8 \times \underbrace{\frac{1}{8}}_{\text{sommet}} + 6 \times \underbrace{\frac{1}{2}}_{\text{centre de face}} = 4$

nbr de M^{2-} $\quad 12 \times \underbrace{\frac{1}{4}}_{\text{milieu des arrêtes}} + \underbrace{1}_{\text{centre du cube}} = 4$

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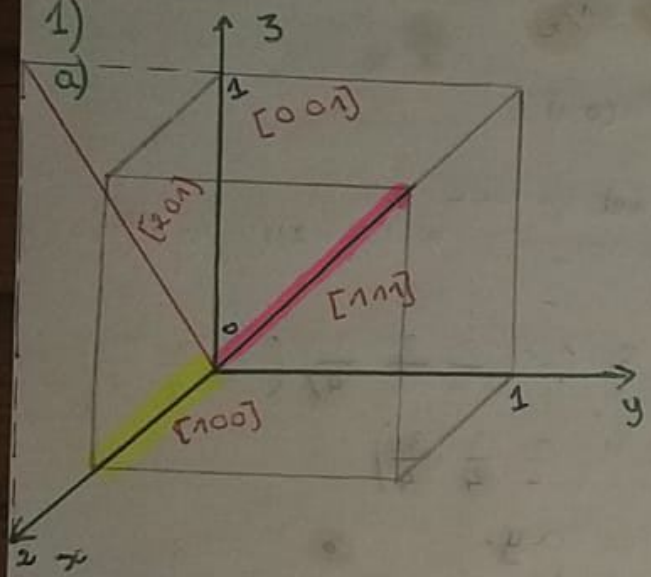

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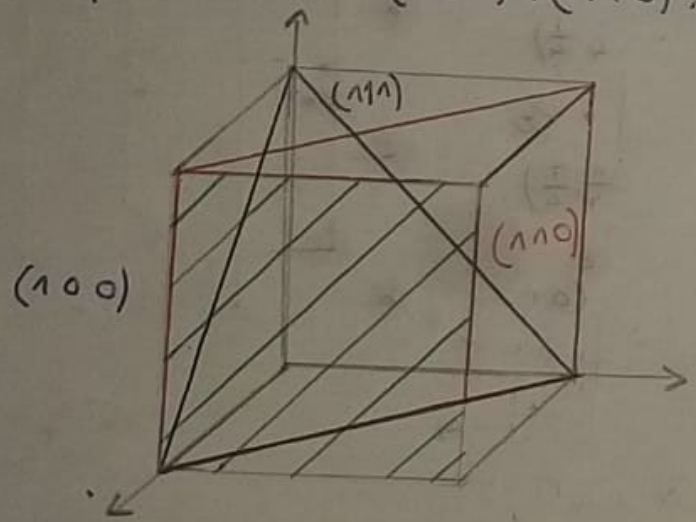

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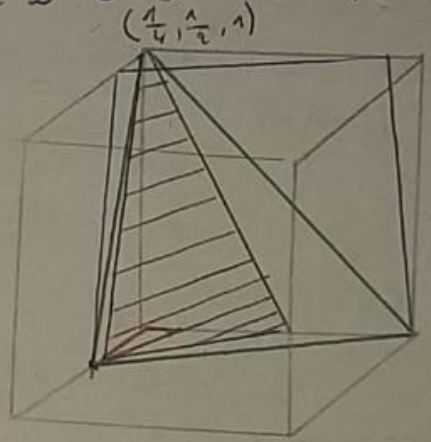
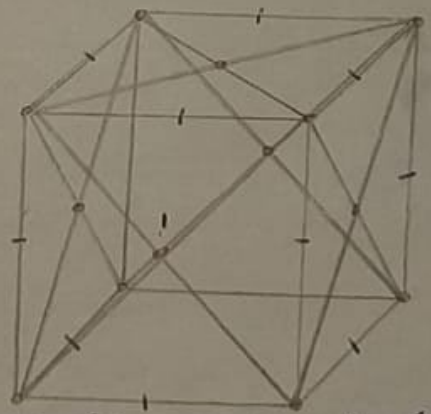


Exercice 2

1)



2) nbr de O^{2-} $\quad 8 \times \underbrace{\frac{1}{8}}_{\text{sommet}} + 6 \times \underbrace{\frac{1}{2}}_{\text{centre de face}} = 4$

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$n_{bn}(O^{2-}) = n_{bn}(Mn^{2+})$ donc la composition stoechiométrique est vérifié

3) Masse Volumique.

$$\rho = \frac{Z.M}{N_a V_{maille}} = \frac{4 \times (24,3 + 16)}{6,08.10^{-23} \times 4,1.10^{-10}}$$

$= 3,88 \text{ g/cm}^3$.

$$C = \frac{n.V_{occupé}}{V_{maille}} = \frac{4 \times \left(\frac{4}{3}\pi R^{+3} + \frac{4}{3}\pi R^{-3}\right)}{a^3}$$

$$= \frac{4 \times \left(\frac{4}{3}\pi \times (0,065)^3 + \frac{4}{3}\pi (0,14)^3\right)}{(4,1.10^{-10})} = 0,73$$

4) D'après la projection sur le plan Oxy.

$2R^+ + 2R^- = a$ (1)

$4R^- \leqslant a\sqrt{2}$ (2)

(1) et (2) $\Rightarrow \frac{R^+}{R^-} \geqslant \sqrt{2} - 1 = 0,41$.

La limite supérieur est imposé par l'existence de la structure

CsCl. $0,73 \geqslant R^+/R^-(MgO) \geqslant 0,414$.

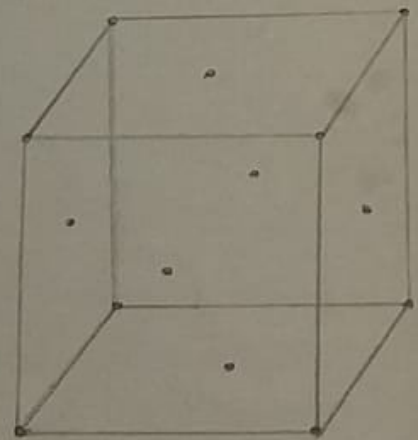
seuls NaI, FeO adoptent la structure NaCl.

Exercice 3

1) $4r = a\sqrt{2}$

$a = 2\sqrt{2}\, r_{(Cu)}$.

$V_{maille} = a^3 = 16\sqrt{2}\, r_{Cu}^3$

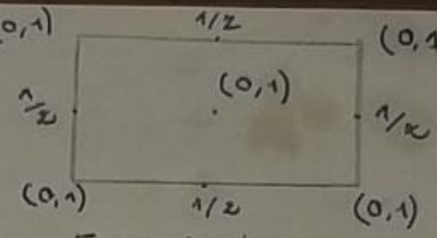


2) $\rho_{th} = \frac{Z.M}{N_a.V_{maille}} =$

$$\frac{4 \times 63,5}{6,02.10^{23}.\left(16\sqrt{2} \times (0,128.10^{-7})^3\right)}$$

$= 8,89 \text{ g/cm}^3$.

$\rho_{th} = 8,89 \text{ g/cm}^3 < \rho_{exp} = 8,94 \text{ g/cm}^3$.

4- 

Exercice 4

1. O^{2-} : CFC → sommet du cube

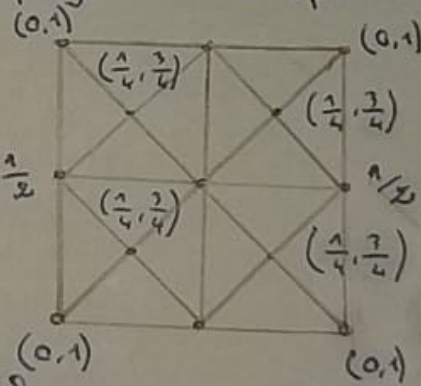
→ centre des faces $(0, 1/2\ 1/2)(1/2\ 1/2\ 0)(1/2\ 0\ 1/2)$

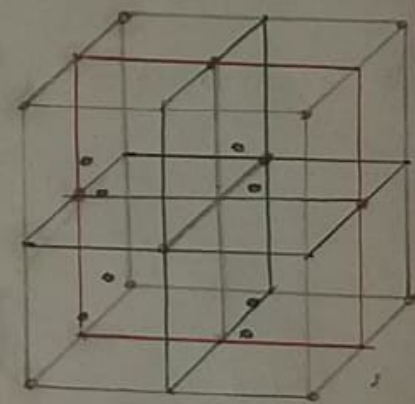
K^+ : site tétraédrique.

$\left(\frac{1}{4}\frac{1}{4}\frac{1}{4}\right)\left(\frac{3}{4}\frac{3}{4}\frac{3}{4}\right)\left(\frac{1}{4}\frac{3}{4}\frac{1}{4}\right)\left(\frac{3}{4}\frac{3}{4}\frac{3}{4}\right)\left(\frac{1}{4}\frac{1}{4}\frac{3}{4}\right)$

$\left(\frac{3}{4}\frac{1}{4}\frac{3}{4}\right)\left(\frac{3}{4}\frac{3}{4}\frac{3}{4}\right)\left(\frac{1}{4}\frac{3}{4}\frac{3}{4}\right)$

2- projection sur le plan Oxy.





3- la coordinence des ions.

$[O^{2-}] = 8$ $\quad [K^+] = 4$

$K_2O \Rightarrow 8 - 4\,O^{2-}$

4- $d_{K^+ - K^+} = \frac{a}{2}$.

$d_{K^+ - O^{2-}} = \frac{a\sqrt{3}}{4}$

$d_{O^{2-} - O^{2-}} = \frac{a\sqrt{2}}{2}$

Exercice 5

1 - Mn_xSe est du type de composé CA.

on calcule $\frac{R_{Mn^{2+}}}{R_{Se^{2-}}} = \frac{0,8}{1,98} = 0,404\ \text{Å}$.

on a $0,22 \leqslant \frac{R_{Mn^{2+}}}{R_{Se^{2-}}} \leqslant 0,414$

Donc Mn_xSe est de structure Z_mS.

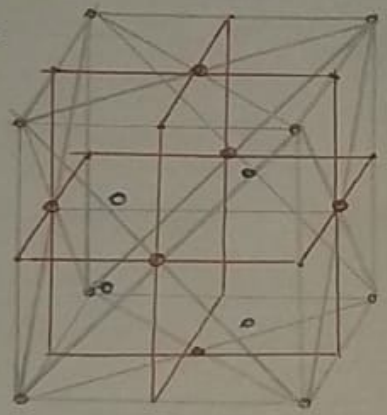
Se^{2-} : CFC.

Mn^{2+} : la moitié de site tétraédrique.

2 - La plus courte distance de Mn_xSe.

$d(Mn_xSe) = R_{Mn^{2+}} + R_{Se^{2-}}$

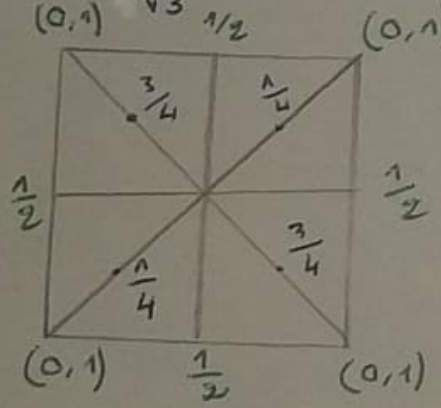
$= 2,78\ \text{Å}$



3 - $d(Mn_x Se) = \frac{a\sqrt{3}}{4}$

$= \frac{4\, d(Mn_x Se)}{\sqrt{3}} = 6,40\ \text{Å}$.

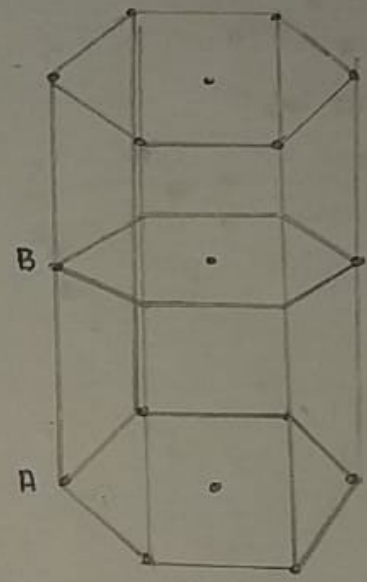
4 -



Exercice 6

1) Représentation de la maille de ce métal.

$Z_m \rightarrow$ HC : empilement compact

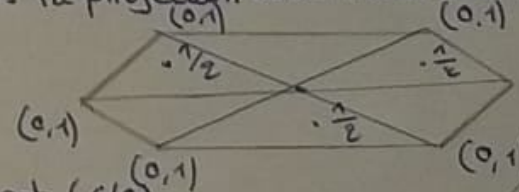


2 - Le nbre de motif par maille

$Z = \underbrace{12 \times \frac{1}{6}}_{\text{sommet}} + \underbrace{2 \times \frac{1}{2}}_{\text{centre de face}} + \underbrace{3}_{\text{plan B}} = 6$

3 - Représentons la projection de la maille sur le plan Oxy

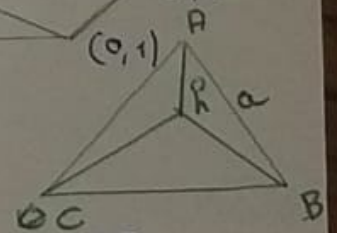
$a = 2R$



4) Le rapport (c/a).

$h^2 + \frac{a^2}{4} = a^2$

$h = \frac{a\sqrt{3}}{2}$



$CG = BG = AG = \frac{2}{3}h = \frac{2}{3}\frac{a\sqrt{3}}{2} = a\frac{\sqrt{3}}{3}$; $a = 2R$

$\frac{c}{2} = R \Rightarrow c = a\sqrt{3}.$

$c/a = \frac{a\sqrt{3}}{a} = \sqrt{3}$